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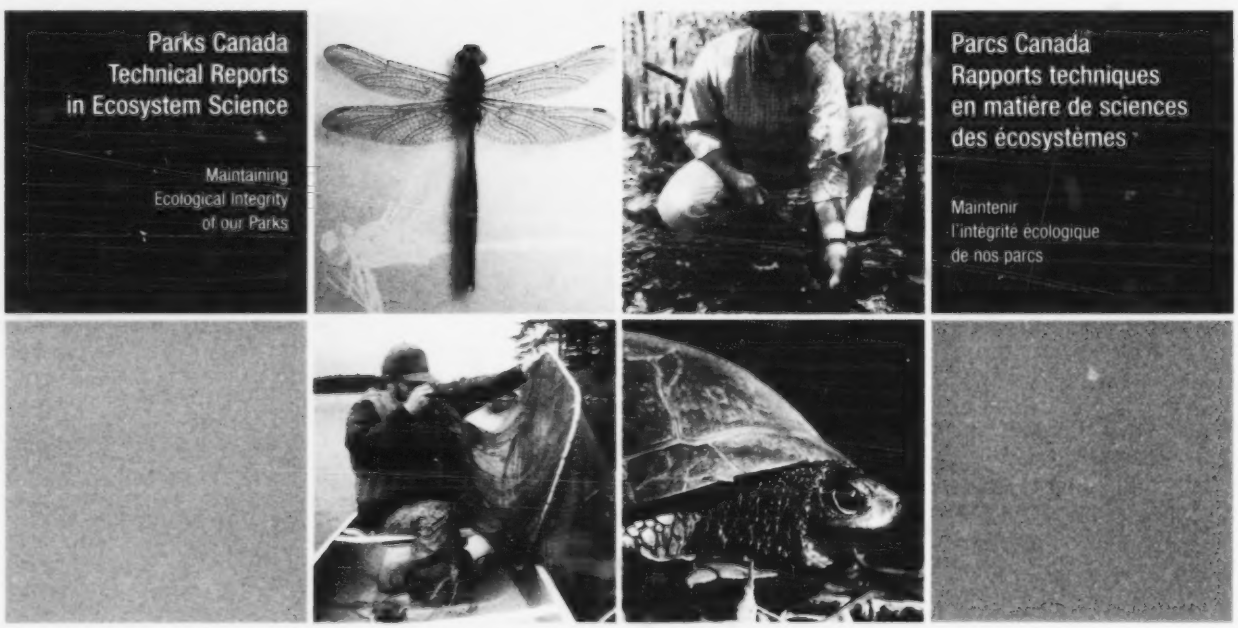
Species Composition, Distribution, and Seasonal Patterns of Dragonflies and Damselflies

of Prince Edward Island National Park

Donna J. Giberson , and
Michelle Dobrin

Report 37
July, 2003



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Report 37

Species Composition, Distribution, and Seasonal Patterns of Dragonflies and Damselflies of Prince Edward Island National Park

by

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July, 2003

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Abstract

Thirty-eight species of Odonata (the damselflies and dragonflies), in 15 genera and 5 families, were found near ponds and streams in Prince Edward Island National Park of Canada between 1997 and 1999. This figure represents about 2/3 of the species so far reported from Prince Edward Island. The Brackley to Dalvay region of the park showed the highest diversity with 36 species, compared to only 19 species in the Cavendish to Rustico area and 13 species in the Greenwich area. This diversity pattern reflects the high diversity of aquatic habitats in the Brackley to Dalvey area, compared to other park regions. The primary flight period for adult odonates was July and August, with 31 of the species found during this period, but several species were found in early June and as late as October.

Résumé

Entre 1997 et 1999, trente huit espèces de l'ordre des Odonates (libellules et demoiselles), regroupés sous 15 genres et 5 familles, ont été recensées près des étangs et rivières du parc national du Canada de l'Île-du-Prince-Édouard. Ce nombre représente près du deux tiers de l'ensemble des espèces de l'île. Le secteur du parc national situé entre Brackley et Dalvey s'avère le plus diversifié avec ses 36 espèces comparées aux 19 espèces du secteur Cavendish à Rustico et aux 13 espèces du secteur Greenwich. Ces résultats démontrent la grande diversité d'habitats aquatiques retrouvés dans le secteur Brackley à Dalvey en comparaison aux deux autres secteurs inventoriés. La période optimale de vol pour les odonates adultes se situe aux mois de juillet et août où un total de 31 espèces ont été recensées. Toutefois, plusieurs espèces ont également été trouvées dès le début juin et ce jusqu'à la fin du mois d'octobre.

Acknowledgements

This research was conducted with the financial support of the Ecosystem Research Fund of Parks Canada, and a Natural Sciences and Engineering Research Council Research Grant to D. Giberson. We would like to extend special thanks to the staff of PEINP for their help and advice throughout the project. Finally we would like to thank the many field assistants and volunteers that helped collect Odonata between 1997 and 1999, including Teri Homer, Michael Curley, Renee Cameron, Chris Campbell, Jerrica Coady, Kathleen Duncan, Jacob Harding, Robert Harding, Mircea Morariu, and Michelle Wall.

Introduction

Damselflies and Dragonflies constitute two suborders within the insect order Odonata (Corbet 1999). The Damselflies (Suborder Zygoptera) are generally small and slender and brightly coloured in blues and greens, and in Prince Edward Island National Park (PEINP), include the Bluets, Forktails, Sprites and Spreadwings. The Dragonflies (Suborder Anisoptera) tend to be stouter and larger than the damsels, and include the showier forms such as the Meadowhawks, Darners, Emeralds and Skimmers. Sixty-six species of Odonata have been reported from Prince Edward Island (Brunelle 1999a, P. Brunelle, Dartmouth N.S., Personal Communication).

Odonate life cycles can extend over several years, depending upon the species, and include an aquatic larval stage (in streams or ponds), followed by a terrestrial flying stage. Both the adults and larvae are predaceous, with the primary food consisting of other insects. The movement between the aquatic (fresh water) and terrestrial habitats represents a major source of energy flow between the two habitats, since larvae accumulate energy in the aquatic habitat and adults provide food for riparian birds and other terrestrial vertebrates (Walker 1953, Corbet 1980, Hynes 1984, Westfall and Tennessen 1996).

Odonate larvae are important components of most fresh water habitats (Corbet 1999), including those within PEINP. They inhabit a wide range of aquatic habitats, including slow moving streams, fast water streams, ponds, lakes, and bogs. High odonate diversity within an area reflects both a diversity of habitat and also the health of those habitats (Bulankova 1997). The objectives of this study are to provide a comprehensive listing of the dragonflies and damselflies found within the Park, with information on their distribution within the park and the periods over which the adults may be seen.

Biology of Odonata

Life cycles of odonates may extend from one year to several years, depending upon the species (Walker 1953, Corbet 1980, Westfall and Tennessen 1996, Corbet 1999). Odonate eggs are deposited in the water or in aquatic plant stems, and usually take from a few days to a month to hatch (although some species show a winter egg diapause). Larvae may moult 10-15 times (depending upon species and environmental conditions) before crawling out of the water to emerge as flying adults. Over a period of several hours, the final stage larva crawls out of the water along the edge of the pond or stream, then the larval skin splits and the adult crawls out, expands its wings, and slowly dries and hardens to the typical adult form. The newly emerged adult (called a "teneral" adult) is soft and usually somewhat dull-coloured compared to the mature adult, and is highly vulnerable to predation. Emergence of the adults may occur throughout the spring, summer and autumn, but different species have different emergence periods. Adults may move considerable distances from the emergence site to feed during their first several days or weeks, before returning to the water to mate. Most are active during bright sunny days, although some species fly at dusk or during late evening. The adult stage may last up to 8 weeks, but averages 1-2 weeks in Zygoptera (Damselflies) and 2-3 weeks in Anisoptera (Dragonflies; Walker 1953).

Odonates exhibit fairly complex mating behaviours, and some species are highly territorial (Walker 1953, Corbet 1980, Westfall and Tennessen 1996). During mating, the male grasps the female behind the head using abdominal claspers, forming the familiar "tandom" flying pattern seen around ponds and streams during the summer. Males deposit their sperm in a pouch located at the base of their abdomen, then the attached female curls her abdomen to the pouch for sperm transfer, forming a "mating wheel". In some species, the males are not present during oviposition, but in many, the males remain attached to the female until

oviposition is complete, to prevent mating with other males. In some other species, the female is released, but males guard the oviposition site, chasing away any other males that enter the area. Eggs may be deposited directly in the water, or inserted into aquatic plants, again depending upon species.

The larvae are inconspicious and are cryptically coloured to blend in with their surroundings (Walker 1953, Corbet 1980). Damselfly larvae are slender and more delicate looking than Dragonfly larvae, and possess 3 prominent leaf-like gills at the end of their abdomens. Dragonfly larvae are robust, with 5 pointed valves at the tip of their abdomen. The larvae of both Suborders have a unique hinged mouthpart (consisting of the labium, or "lower lip") which can be extended to catch their prey, which consists of a wide variety of aquatic invertebrates. In contrast, most adults are bright and showy, and are conspicuous on sunny days near the bodies of water in which they breed. They are also predators, and feed on flying invertebrates, including mosquitoes and black flies. Odonates are a small Order of insects, with about 5000 species known throughout the world (Corbet 1980). One hundred and thirty-one species have been recorded from Atlantic Canada, and 66 of these have been found in Prince Edward Island (Brunelle 1999a, P. Brunelle, Dartmouth N.S., Personal Communication).

Materials and Methods

Adult odonates were collected through aerial netting during the summers of 1997, 1998 and 1999. Collections during 1997 and 1998 were carried out as an addition to baseline aquatic stream surveys within the park (Giberson and Dobrin 1998, Dobrin and Giberson 1999), and a more intensive weekly survey was conducted during the summer of 1999. In 1997, aerial netting occurred between July and October along streamside locations sampled for the 1997 baseline survey [i.e. along Balsam Hollow Brook (Fig. 1A), and the inlet to Long Pond (Fig. 1B)]. In 1998, the collections were intensified so that weekly collections occurred from late May to October over a more extensive area of the park. During 1998, collection sites included sites in the Cavendish/Rustico area (Clarke's Pond, The Lake of Shining Waters, the impoundment near Green Gables house on Balsam Hollow Brook, and Rolling's Pond; Fig. 1A) and the Stanhope/Brackley/Dalvay area (John Archie's Pond, Bell's Pond, Will's Pond, and Long Pond, Dalvay Pond, and Campbell's Pond; Fig. 1B). The 1999 collections (May-Sept.) included all sites visited in previous years, but also included a number of new sites in the Greenwich area (Bowley Pond, Bog Pond, Long Pond and Schooner Pond; Fig. 1C).

Odonates were collected by netting specimens with a large diameter sweep net. Specimens that could be identified in the field were recorded and released; those that required laboratory identification or which represented a first record for the area were transferred by hand into small envelopes, following the protocol in Brunelle (1994). In the laboratory, specimens were force-dried in acetone for up to 24 hours, to preserve body pigments required for identification (Brunelle 1994). Odonata specimens were identified using the keys of Walker (1953), Needham and Westfall (1954), Walker (1958), Walker and Corbet (1975) and Westfall and May (1996), and identifications were verified by R. Harding and P.-M. Brunelle (Atlantic Dragonfly Inventory Project). Voucher specimens have been deposited at the New Brunswick Museum, Saint John, NB.

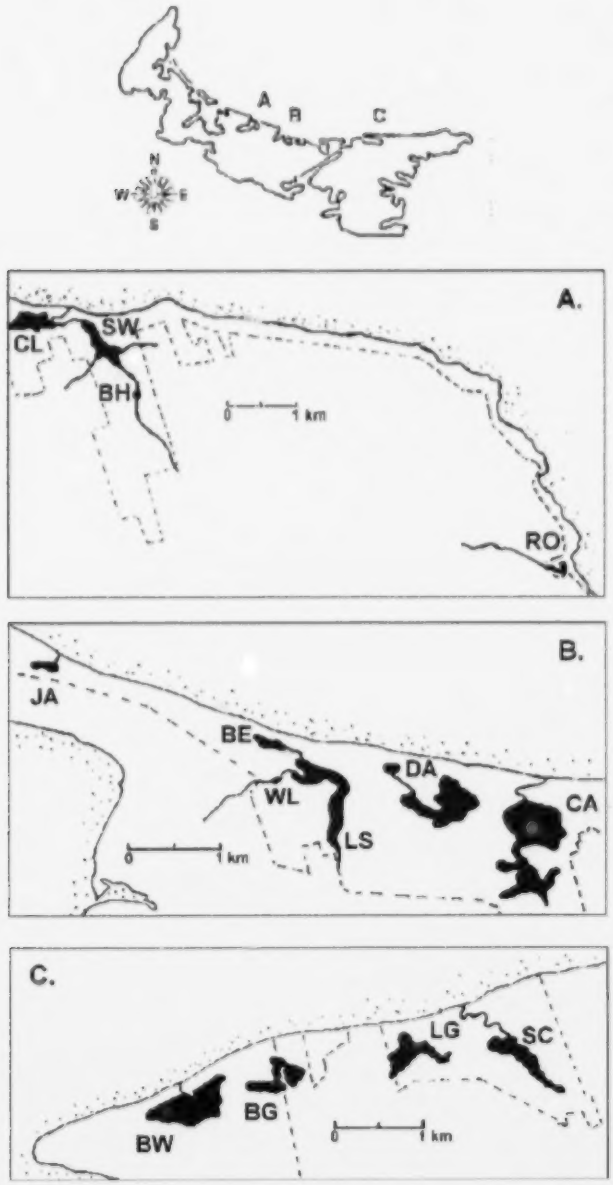

Fig. 1. PEI National Park, showing 1997-1999 Odonate collection sites

KEY:

A. Cavendish/Rustico Area: CL-Clark's Pond, SW-Lake of Shining Waters, BH-Balsam Hollow Brook, RO-Rolling's Pond

B. Stanhope/Brackley/Dalvay Area: JA-John Archie's Pond, BE-Bell's Pond, LS-Long Pond (Stanhope), WL-Will's Pond, DA-Dalvay Pond, CA-Campbell's Pond

C. Greenwich Area: BW-Bowley Pond, BG-Bog Pond, LG-Long Pond (Greenwich), SC-Schooner Pond

Results and Discussion

Species Diversity and Distribution

Sixty-six species of Odonata have been reported so far from Prince Edward Island (Brunelle 1999a, P. Brunelle, Personal Communication). A total of 38 species in 15 genera and 5 families were collected or observed in PEI National Park between 1997 and 1999 (Table 1). The most common species were the White-faced Meadowhawk (*Sympetrum obtrusum*), Hagen's Bluet (*Enallagma hageni*), and the Eastern Forktail (*Ischnura verticalis*), all of which were found throughout the park (Table 1), and in generally high numbers.

Species diversity varied in the different areas of the park (Table 1), apparently relating to the diversity of the habitat within each area. The highest number of species (36) was found near ponds and trails in the Stanhope/Brackley area, particularly around Long Pond and the Farmlands and Bubbling Springs trails (Table 1). This region also showed the largest diversity of habitat types, including ponds, springs, streams, bogs, and marshes. The lowest number of species (13) was found in Greenwich, which was only included in sampling in the final year. Nineteen species were found in the Cavendish area. Ten species were found in all three regions of the park.

Adult Damselflies and Dragonflies were first noted in early June in those years when collections began in May, and were recorded from early June to early October (Fig. 2). Most species (31 of the 38 species found in the park) were summer fliers, and were most common during July and August. A few species (e.g. *Enallagma boreale*, *Epitheca canis*, and *Leucorrhinia hundonica*) were only found in early summer, and one species (*Lestes congener*) had a flight period that extended at least into October.

Species-specific Patterns

Nine hundred and fifty-one specimens of Odonata were observed or collected between 1997 and 1999. In the Suborder Zygoptera (Damselflies), there were four species in the family Lestidae and seven species in the Family Coenagrionidae. Within the Anisoptera, there were six species of Aeshnidae, nine species of Corduliidae, and 12 species of Libellulidae. Species making up 5% or more of the total over the three years were considered to be common.

Suborder Zygoptera (the Damselflies)

Family Lestidae (Spreadwings)

Spreadwings are a group of relatively large and elongate damselflies (Westfall and May 1996). This group is distinguished from most other damselflies by holding their wings slightly apart when at rest rather than directly over their backs. Spreadwings breed in still waters such as marshes, bogs, ponds, and small lakes. Only one genus (*Lestes*) occurs in Canada.

Lestes congener Hagen [the Spotted Spreadwing] is found in all Atlantic provinces (including Newfoundland; Brunelle 1997) and west to British Columbia (BC) and north to the Northwest Territories (NWT; Walker 1953, Westfall and May 1996). It breeds in permanent and semi-permanent ponds and in slow areas of streams (Walker 1953). In PEINP, *L. congener* made up about 5% of the Odonata recorded, and was found in both the Cavendish and Stanhope regions of the park (Table 1). The recorded adult flight periods varied considerably over the three years, but the species was generally a mid to late summer flyer, with adults recorded as late as October (Fig. 2). This pattern was consistent with that reported in Quebec (Larochelle 1978, Hilton 1981), Maine (Brunelle 1999b) and Saskatchewan (Sawchyn and Gillott 1975).

Table 1. Distributions of the 38 species of Odonata collected around freshwater habitats in Prince Edward Island National Park from 1997 to 1999. Symbols indicate large ponds (✚), small ponds (●), and beaver pond (▲).Site abbreviations are as follows: A) Cavendish-North Rustico region: CL - Clarke's Pond, SW - Lake of Shining Waters, BH - Balsam Hollow Brook impoundment, RO - Rolling's Pond; B) Stanhope-Brackley-Dalvay region: JA - John Archie's Pond, BE - Bell's Pond, WL - Will's Pond, LS - Long Pond, Stanhope, DA - Dalvay Pond, CA - Campbell's Pond; C) Greenwich region: BW - Bowley Pond, BG - Bog Pond, LG - Long Pond, Greenwich, SC - Schooner Pond.

	Cavendish-North Rustico				Stanhope-Brackley-Dalvay								Greenwich			
	CL	SW	BH		RO	JA	BE	WL	LS	DA	CA		BW	BG	LG	SC
ZYGOPTERA																
Lestidae																
Lestes congener Hagen			●			●		▲	✚	●	✚					
L. disjunctus disjunctus Selys	✚	✚				●	●	▲	✚	●	✚		●	●		✚
L. dryas Kirby									✚	●						
L. forcipatus Rambur										●						
Coenagrionidae																
Coenagrion resolutum (Selys)	✚					●										
Enallagma boreale Selys		✚				●	●	▲	✚	●						
E. cyathigerum (Charpentier)						●	●	▲								
E. ebrium (Hagen)	✚	✚			●			▲		●	✚			●		
E. hageni (Walsh)	✚	✚	●			●	●	▲	✚	●	✚			●	✚	✚
Ischnura verticalis (Say)	✚	✚	●		●	●	●	▲	✚	●	✚		●			
Nehalennia irene (Hagen)						●			✚					●		
ANISOPTERA																
Aeshnidae																
Aeshna canadensis Walker			●			●	●		✚					●	✚	✚
A. constricta Say	✚	✚	●			●	●									
A. interrupta interrupta Walker	✚					●	●	▲	✚	●				●	✚	✚
A. tuberculifera Walker								▲								
A. umbrosa umbrosa Walker							●	▲	✚	●	✚					
Anax junius (Drury)										✚						
Corduliidae																
Cordulia shurtleffi Scudder						●	●	▲	✚							
Dorocordulia libera (Selys)									✚					●		✚
Epitheca canis (McLachlan)								▲								
E. spinigera (Selys)									✚							
Somatochlora elongata (Scudder)									✚							
S. franklini (Selys)									✚							
S. kennedyi Walker									✚							
S. walshii (Scudder)	✚							▲	✚							
S. williamsoni Walker	✚							▲	✚	●	✚			●		
Libellulidae																
Leucorrhinia hudsonica Selys									✚							
L. intacta (Hagen)						●		▲	✚							
L. proxima Calvert						●	●	▲	✚	●				●		
Libellula julia Uhler										●						
L. lydia Drury		✚	●					▲	✚							
L. quadrimaculata Linneaus	✚	✚	●			●	●	▲	✚	●	✚			●		✚
Pantala flavescens (Fabricius)			●													
Sympetrum costiferum (Hagen)	✚	✚	●				●		✚	●	✚					
S. internum Montgomery	✚	✚	●						✚		✚					
S. obtrusum (Hagen)	✚	✚	●			●	●	▲	✚	●	✚		●	●		✚
S. rubicundulum (Say)		✚	●		●	●				●	✚				✚	
S. vicinum (Hagen)								▲								
Total number of species	13	12	12		3	17	14	20	25	17	13		3	11	4	8

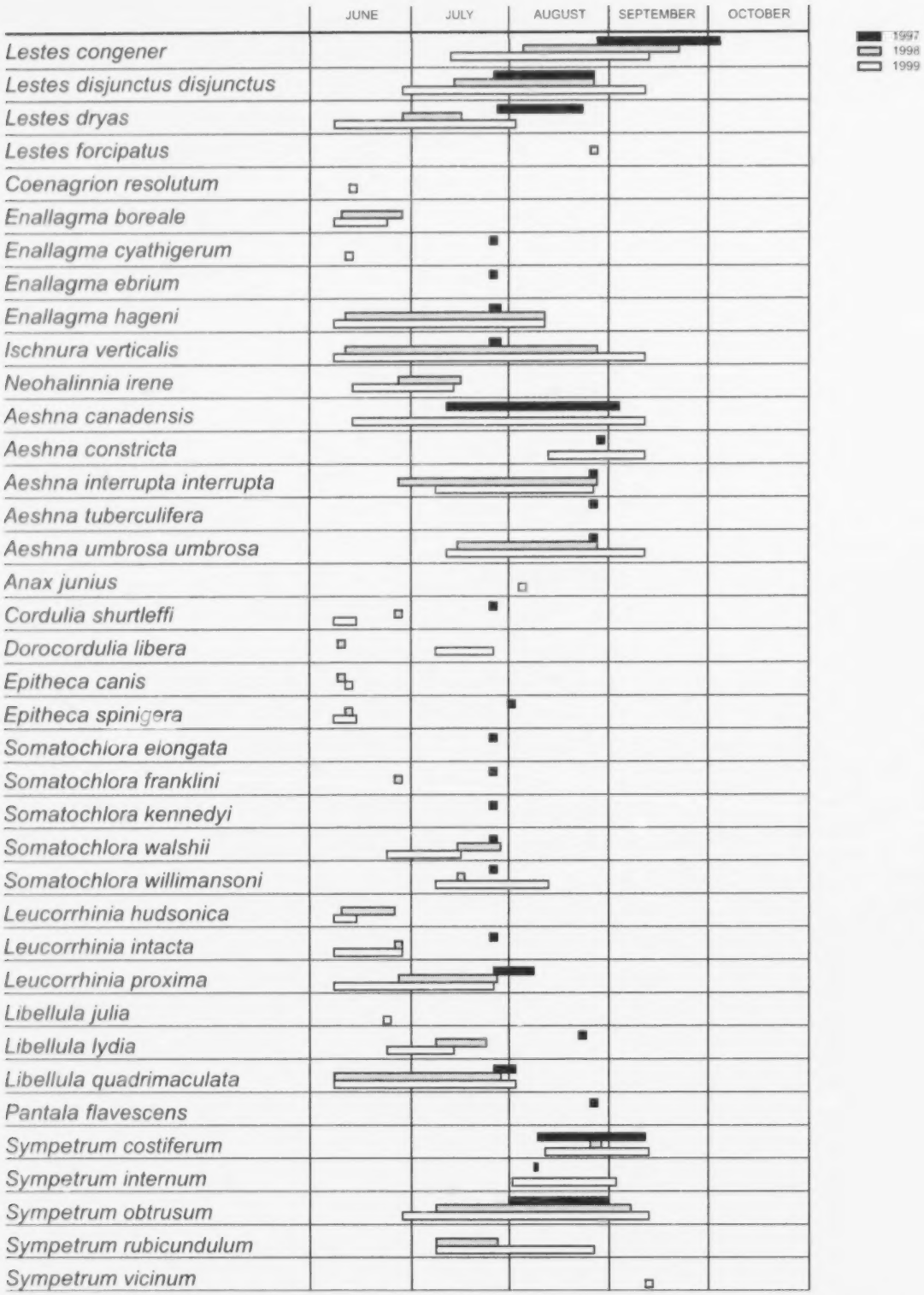

Figure. 2. Flight periods of PEINP Odonata. Bars indicate the dates when adults of each species was observed flying in Prince Edward Island National Park, 1997-99.

Lestes disjunctus disjunctus Selys [the Common Spreadwing] is widely distributed in marshy and boggy habitats from the Atlantic provinces to BC and north to NWT (Walker 1953, Westfall and May 1996). The species was common in PEINP (8% of the total) and was recorded from most collecting areas and in all three regions of the park (Table 1). Its flight period ranged from late June to mid-September in PEINP (Fig. 2), consistent with the pattern in Quebec (Fernet and Pilon 1971, Larochelle 1978, Hilton 1981) and Maine (Brunelle 1999b).

Lestes dryas Kirby [the Emerald Spreadwing] is found in permanent and temporary ponds or slow areas of streams (Walker 1953). It has a holarctic distribution, and is found in the Maritime Provinces [not in Newfoundland (Nfld)] west to BC, and north to NWT, Yukon, and Alaska (Walker 1953, Brunelle 1997). In PEINP, *L. dryas* was most common near a temporary bog pond along the Farmlands trail, and it made up about 3.5% of the observed odonate population (Table 1). Adults were observed between early June and late August (Fig. 2), which is consistent with the flight pattern in Quebec (Larochelle 1978, Pilon and Sylvestre 1984), Ontario (Holder 1996), Maine (Brunelle 1999b) and Saskatchewan (Sawchyn and Gillott 1974).

Lestes forcipatus Rambur [the Sweetflag Spreadwing] was represented by a single mating pair collected along the Reeds and Rushes trail near Dalvay Pond (Table 1) in late August (Fig. 2). This species prefers marshy areas or slow weedy streams and is found from the Maritime Provinces west to Saskatchewan (Walker 1953). The flight period ranges from June to September in Maine (Brunelle 1999b).

Family Coenagrionidae (the Pond Damsels)

The Coenagrionidae are small and delicate damsels that generally prefer still water (Westfall and May 1996). This is the largest and most diverse damselfly family in North America. They are usually brightly coloured (rarely with a metallic shine) and often spotted with bright blue or green. Four genera were found in PEINP, including several Bluets (*Coenagrion* and *Enallagma* species), one Forktail (*Ischnura*) and one Sprite (*Nehalennia*).

Coenagrion resolutum (Selys) [the Taiga Bluet] is a common and widely distributed damselfly in Canada, extending from the Atlantic provinces west to BC and north to NWT (Walker 1953, Westfall and May 1996, Brunelle 1997). It is found in ponds and marshes (Westfall and May 1996) and is widespread across the north since it can tolerate cold climates (Walker 1953). The species was rare in PEINP (<1% of total) and was collected at only two sites, but it ranged over both the Cavendish and Stanhope areas the Park (Table 1). All specimens were collected in early June (Fig. 2), but the flight period in neighbouring localities extends through June and July (Larochelle 1978, Pilon and Sylvestre 1984, Hilton 1990, Brunelle 1999b).

Enallagma boreale Selys [the Boreal Bluet] breeds in still waters and small streams (Westfall and May 1996). It is the most widely distributed of the *Enallagma* species in Canada, and is the commonest species in the far north (Walker 1953). It was rare in PEINP (1.7% of total), and was collected throughout the Stanhope region and at one site in the Cavendish area (Table 1). Adults were only observed in June (fig. 2), but have been recorded between May and July or August in Quebec (Larochelle 1978, Hilton 1981), Maine (Brunelle 1999b) and in other locations in PEI (Hilton 1990).

Enallagma cyathigerum (Charpentier) [the Northern Bluet] is another widely distributed Bluet, ranging from the Atlantic provinces to BC, NWT, and Yukon, and also Europe (Parr 1976, Westfall and May 1996, Brunelle 1997). It breeds in most freshwater habitats but is not tolerant of acid or saline waters. It was a rare species in PEINP (<1% of total) and was only recorded

from the Stanhope/Brackley/Dalvay region of the park (Table 1). Adults were observed in June and July in PEINP (Fig. 2) but have been recorded from June to August in other PEI locations (Hilton 1990) and Quebec (Pilon and Sylvestre 1984) and from May to August in Maine (Brunelle 1999b).

Enallagma ebrium (Hagen) [the Marsh Bluet] is also distributed across Canada (Westfall and May 1996, Brunelle 1997). It breeds in marshes and ponds, but not in acid waters. The Marsh Bluet was relatively common in PEINP (just under 5% of total) and was widely distributed through all the regions of the park (Table 1). Adults were recorded between late June and early September (Fig. 2), which is a little later than the June to August pattern recorded in Quebec (Larochelle 1978, Pilon and Sylvestre 1984) and Maine (Brunelle 1999b)

Enallagma hageni (Walsh) [Hagen's Bluet] breeds in ponds, marshes, and open bogs from the Maritimes to BC (Westfall and May 1996). It was the most common Bluet in PEINP (16% of total) and was found in all three regions, and in most of the collection sites (Table 1). The flight period ranged from early June to the middle of August (Fig. 2), a pattern consistent with that reported for other PEI locations (Hilton 1990), Quebec (Pilon and Sylvestre 1984, Hilton 1981), Maine (Brunelle 1999b), and Ontario (Holder 1996).

Ishnura verticalis (Say) [the Eastern Forktail] is found around still waters, slow streams and backwaters and is primarily eastern in distribution (Westfall and May 1996). In Canada, it ranges from the Maritime Provinces (Brunelle 1997) to Manitoba (Westfall and May 1996). The Eastern Forktail was a common species in PEINP (12.6% of total), and was widely distributed. It was found in all sites in the Cavendish and Stanhope areas, and in one site at Greenwich (Table 1). This species has an extended flight period which may extend from May to September in Maine (Brunelle 1999b). In PEINP, adults were observed between early June and the middle of September (Fig. 2), which is the pattern that has been reported in other areas of PEI (Hilton 1990), Quebec (Hilton 1981, Pilon and Sylvestre 1984) and Ontario (Holder 1996).

Nehalennia irene (Hagen) [the Sedge Sprite] is found in boggy waters, marshes, and sedge fens across Canada and north to NWT. It was a rare species in PEINP (1% of total) and was found in two sites in the Stanhope area and one site in Greenwich (Table 1). It was observed flying from the middle of June to the middle of July in PENP (Fig. 2), but the flight period extends to August in Quebec (Pilon and Sylvestre 1984) and Maine (Brunelle 1999b).

Suborder Anisoptera (the Dragonflies)

Family Aeshnidae (Darners)

The Darners are a large and showy group, and are one of the most conspicuous species in the Park. All six species recorded from PEINP were fairly rare.

Aeshna canadensis Walker [the Canada Darner] breeds in marshes, boggy areas of lakes and ponds, and in sluggish streams (Walker 1958). It has been recorded in all 10 provinces, but is more common in the east than the west (Walker 1958). The Canada Darner made up only about 1% of the total Odonata in the Park, but was widely distributed through all three regions (Table 1). Adults were seen throughout the summer, from early June to the middle of September (Fig. 2), a pattern consistent with that reported in Quebec (Pilon and Sylvestre 1984) and Maine (Brunelle 1999b), but which extends the previously known PEI flight period (Hilton 1990).

Aeshna constricta Say [the Lance-tipped Darner] breeds in waters with emergent vegetation, such as open marshes, some ponds, and slow streams (Walker 1958). It is mainly eastern in distribution, but has been reported from the Maritimes (Brunelle 1997) to BC (Walker 1958). In PEINP, it was a rare species (<1% of total) and was found in a few sites in the Cavendish and Stanhope areas of the park (Table 1). It has been reported to be a late summer flyer (Hilton 1981, Brunelle 1999b), and in PEINP adults were observed between mid-August and mid-September (Fig. 2).

Aeshna interrupta Walker [the Variable Darner] has three subspecies in North America; *A. interrupta lineata* and *A. interupta interna* are western and *A. interrupta interrupta* is eastern. The Variable Darner breeds in most standing and slow water habitats in the northeastern states and provinces (Walker 1958, Brunelle 1997). The species was fairly rare (1.5%) but was found throughout the park (Table 1). Flight periods ranged between the end of June and the end of August (Fig. 2), compared to June to September in Quebec (Larochelle 1978, Pilon and Sylvestre 1984) and July to October in Maine (Brunelle 1999b).

Aeshna tuberculifera Walker [the Black-tipped Darner] prefers the grassy or boggy edges of still water bodies and is found from the Maritimes to BC (Walker 1958, Brunelle 1997). In PEINP, it was represented by a single individual found near Will's Pond in the Stanhope/Brackley/ Dalvay area of the park (Table 1) at the end of August (Fig. 2). It is reported to be a late summer flyer, with flight periods extending from July or August through to October (Larochelle 1978, Holder 1996, Brunelle 1999b).

Aeshna umbrosa umbrosa Walker [the Shadow Darner] is found around partly shaded streams and ditches (Walker 1958), where it is most active in late afternoon and evening during summer (Walker 1958). The Shadow Darner is found in all Canadian provinces and north to NWT and Yukon (Needham and Westfall 1954, Brunelle 1997). In PEINP, it was rare (only 1% of total) but was found in virtually all the habitats sampled in the Stanhope/Brackley/ Dalvay region (Table 1). Adults were recorded from the middle of July to the middle of September (Fig. 2), a pattern consistent with that reported in Quebec (Pilon and Sylvestre 1984). In Maine, the flight period extended from July to October (Brunelle 1999b).

Anax junius (Drury) [the Common Green Darner] is a migratory species that moves into Canada from the south each spring as well as having a resident population throughout much of its Canadian range (Trottier 1971). Its distribution is transcontinental, extending southward to Central and South America (Needham and Westfall 1954). The Common Green Darner breeds in still or slow moving water with abundant emergent vegetation (Walker 1958). It was rare in PEINP, represented by a single individual found near Campbell's Pond in the Stanhope/Brackley/Dalvay area (Table 1) in early August (Fig. 2). Reported flight periods elsewhere extend from April through September (Larochelle 1978, Hilton 1981, Brunelle 1999b), but this usually includes two flight peaks. The first peak corresponds to the migratory population, and the second, later in the summer, represents adults from the resident population (Needham and Westfall 1954).

Family Corduliidae (the Emeralds)

The Emeralds are a group of brilliantly coloured and strong-flying dragonflies. Most Emeralds have iridescent green eyes, a character which give the group its name (Needham and Westfall 1954, Walker and Corbet 1975). Most species in this family are found in streams and lakes with plenty of oxygen (Walker and Corbet 1975). Nine species of Corduliidae were observed in PEINP, but all of them were quite rare.

Cordulia shurtleffi Scudder [the American Emerald] prefers to breed in still waters, such as marshes and bogs. It is primarily northern in distribution and is found across Canada and into NWT and Yukon (Walker and Corbet 1975). In PEINP, the American Emerald was relatively rare (1.2% of total) and was found around most habitats in the Stanhope/Brackley/ Dalvay region (Table 1). American Emeralds were collected between early June and early August (Fig. 2). The species had been previously reported in PEI in July (Hilton 1990), in Quebec during June and July (Hilton 1981, Pilon and Sylvestre 1984), and in Maine between May and July (Brunelle 1999b).

Dorocordulia libera (Selys) [the Racket-tailed Emerald] is found near bogs, ponds, marshy edges of lakes and in slow streams (Walker and Corbet 1975). The Racket-tailed Emerald is an eastern species, ranging through the maritime provinces and the northeastern states (Walker and Corbet 1975, Brunelle 1997). In PEINP, the species was rare (<1%) and only found near one site in the Stanhope region and one site in Greenwich (Table 1). Adults were seen between

early June and the end of July, which is consistent with the pattern reported in Quebec (Hilton 1981, Pilon and Sylvestre 1984). In Maine, the species was recorded flying between May and August (Brunelle 1999b).

Epitheca canis (McLachlan) [the Beaverpond Baskettail] is transcontinental in distribution (excluding Nfld), but is generally northern, and prefers to breed in acid bogs and beaver ponds (Walker and Corbet 1975, Perry 1977). Only three specimens were observed over the three years in PEINP, all of them near Will's Pond in the Stanhope area (Table 1) in early June (Fig. 2). The Beaverpond Baskettail has an early summer flight period throughout its range, flying from May to July in Quebec and Maine (Hilton 1981, Pilon and Sylvestre 1984, Brunelle 1999b). The previous record in PEI occurred during June (Hilton 1990).

Epitheca spinigera (Selys) [the Spiny Baskettail] breeds in marshy edges of lakes and slow streams across the country (Walker and Corbet 1975). In PEINP, it was rare (<1%) and was found only around Long Pond in the Stanhope area (Table 1). Adults were collected in early June in 1998 and 1999, and in early August in 1997 in PEINP (Fig. 2), but in Quebec, they have only been reported from May to June (Larochelle 1978, Pilon and Sylvestre 1984), and from May to July in Maine (Brunelle 1999b). Walker and Corbet (1975) report a flight period from May to August.

Somatochlora elongata (Scudder) [the Ski-tailed Emerald] breeds in streams and ponds, and is eastern in distribution (Walker and Corbet 1975, Brunelle 1997). The species was rare in PEINP, with a single individual found near Long Pond (Stanhope/Brackley/Dalvay area; Table 1) in July 1997 (Fig. 2). The Ski-tailed Emerald flies throughout the summer in other localities, and has been reported in June and July in Quebec (Larochelle 1978) and from June to August in Maine (Brunelle 1999b).

Somatochlora franklini (Selys) [the Delicate Emerald] breeds in spring-fed sphagnum bogs (Walker 1925) and ranges from the Atlantic provinces to Saskatchewan (Walker 1925, Brunelle 1997). The Delicate Emerald was rare in PEINP (<1%) and was found only near Long Pond (Stanhope area, Table 1) between late June and late July (Fig. 2). It emerges throughout the summer (May to September) over its range, and has been reported between June and August in Maine (Brunelle 1999b).

Somatochlora kennedyi (Walker) [Kennedy's Emerald] prefers shallow boggy waters and has a northeastern distribution, extending from the maritime provinces westward to Manitoba and north to NWT (Walker 1925, Walker and Corbet 1975, Perry 1977, Brunelle 1997). Only one individual was observed in PEINP, near Long Pond (Stanhope/Brackley/ Dalvay area; Table 1) in late July (Fig. 2). The reported flight period elsewhere in its range is from May to August (Walker 1925), and it was observed in Maine during June and July (Brunelle 1999b).

Somatochlora walshii (Scudder) [the Brush-tipped Emerald] has a transcontinental distribution and has been reported in slow streams that run through bogs and marshes (Walker and Corbet 1975). It was rare in PEINP (<1%), and was found in one Cavendish site and two Stanhope sites (Table 1). Reported flight periods generally extend between July and August (Quebec; Larochelle 1978, Hilton 1981, Pilon and Sylvestre 1984) or June and August (Maine; Brunelle 1999b). In PEINP, adults were recorded between the end of June and the end of July (Fig. 2).

Somatochlora williamsoni Walker [Williamson's Emerald] prefers slow streams through shaded forested areas, and has been reported from PEI and NB in the maritime provinces to Quebec, Ontario, and Manitoba (Walker and Corbet 1975). Williamson's Emerald was rare (<1%), but was widely distributed in the park. Walker (1925) reported an adult flight period of June through September, but in PEINP adults were seen between mid-July and mid-August (Fig. 2), a pattern consistent with that in Quebec (Hilton 1981) and Maine (Brunelle 1999b).

Family Libellulidae (the Skimmers)

The Skimmers are the largest family within the Anisoptera. They are distinguished from other dragonflies by their characteristic wing venation and wide, flat abdomen (Needham and Westfall 1954, Walker and Corbet 1975). The Libellulids

were the largest family found in PEINP, with 12 species recorded, including the most common species in the park.

Leucorrhinia hudsonica Selys [the Hudsonian Whiteface] breeds in cold marshes, bogs, and ponds. It is circumboreal in distribution, and is found across Canada and northward into NWT, Alaska, and Yukon (Walker and Corbet 1975). The species was rare in PEINP (<1% of total), and only found near a temporary bog along the Farmlands Trail near Long Pond (Stanhope/Brackley/Dalvay area; Table 1) in June (Fig. 2). It has been reported throughout the summer in most locations (Larochelle 1978, Hilton 1981, Hilton 1990, Brunelle 1999b).

Leucorrhinia intacta (Hagen) [the Dot-tailed Whiteface] is also transcontinental, and breeds in ponds and streams (Walker and Corbet 1975). The Dot-tailed Whiteface was rare (1.3% of total) and was found around half the sites in the Stanhope area (Table 1). The flight period of June and July (Fig. 2) is consistent with that reported in Quebec (Pilon and Sylvestre 1984), but the species has been reported from May to August in Maine (Brunelle 1999b).

Leucorrhinia proxima Calvert [the Red-waisted Whiteface] prefers marshes and bogs across the country and northwards to NWT and Yukon (Walker and Corbet 1975, Brunelle 1997). It was relatively common in PEINP (3.4% of total) and also more widely distributed than the other Whitefaces, observed around sites throughout Stanhope and Greenwich (Table 1). Adults were collected between early June and the middle of August (Fig. 2), consistent with reports from Quebec (Fernet and Pilon 1971, Pilon and Sylvestre 1984) and Maine (Brunelle 1999b).

Libellula julia Uhler (Chalk-fronted Corporal) breeds in bogs and ponds and is transcontinental in distribution (Walker and Corbet 1975). A single individual was captured near Dalvay Pond (Table 1) near the end of June (Fig. 2), but Chalk-fronted Corporals have been reported in June and August in Quebec (Fernet and Pilon 1971, Pilon and Sylvestre 1984) and between May and August in Maine (Brunelle 1999b).

Libellula lydia Drury [the Common Whitetail] prefers small ponds or slow moving streams (Walker and Corbet 1975, Koenig and Albano 1987), and can be found from the maritime provinces to BC (Walker and Corbet 1975). It was quite rare in PEINP (1.2% of total), but quite widely distributed; 11 individuals were caught at two sites around Cavendish and two sites around Stanhope (Table 1) between late June and late August (Fig. 2). A mid-summer flight pattern has been reported in other neighbouring locations as well (Larochelle 1978, Hilton 1981, Pilon and Sylvestre 1984, Hilton 1990, Brunelle 1999b).

Libellula quadrimaculata Linnaeus [the Four-spotted Skimmer] breeds in marshes and peat bogs and has a circumboreal distribution (Walker and Corbet 1975). The Four-spotted Skimmer was relatively common (4.8% of total) and widespread in PEINP (Table 1). Adults were recorded throughout most of June and July and early into August (Fig. 2), consistent with the pattern reported throughout PEI by Hilton (1990), and elsewhere in the region (Pilon and Sylvestre 1984, Brunelle 1999b).

Pantala flavescens (Fabricius) (Wandering Glider) has a worldwide distribution, and is widely reported to drift over most of the world with wind patterns (Carpenter 1997). It has been reported throughout the maritime provinces with the exception of New Brunswick (Brunelle 1997), and the PEINP report is the first record of its occurrence in PEI (Brunelle 1999). It usually breeds in temporary pools or streams (Mathavan 1979, Dunkle 1989). It was represented by a single mating pair collected near Green Gables in the Cavendish area (Table 1) at the end of August (Fig. 2), but has been reported from June to September in Maine (Brunelle 1999b).

Sympetrum costiferum (Hagen) [the Saffron-winged Meadowhawk] is found from the maritime provinces to BC, and breeds in marshes and ponds (Walker and Corbet 1975). It is a late summer species (Fernet and Pilon 1971, Larochelle 1978, Pilon and Sylvestre 1984, Hilton 1990, Brunelle 1999b). It was relatively rare in PEINP (<3% of total) but was widespread in the park (Table 1) during August and September (Fig. 2).

Sympetrum internum Montgomery [the Cherry-faced Meadowhawk] prefers shady ponds and slow streams across Canada and

into NWT(Walker and Corbet 1975). It was rare in PEINP (2.4% of total) but widely distributed throughout the Cavendish and Stanhope regions of the park (Table 1). Adults were seen in August and September (Fig. 2) in PEINP, but have been reported between July and September elsewhere in PEI (Hilton 1990), from June to August in Quebec (Larochelle 1978, Pilon and Sylvestre 1984) and June to September in Maine (Brunelle 1999b).

Sympetrum obtrusum (Hagen) [the Whitefaced Meadowhawk] breeds in most freshwater habitats from the maritime provinces to BC and north to NWT (Walker and Corbet 1975). It was the most common odonate found in the park (18.4% of total), and it was collected from all three regions (Table 1). Walker and Corbet (1975) report a flight period between June and October, but in Maine (Brunelle 1999b) and PEINP, adults were recorded between the end of June and the middle of September (Fig. 2). In Quebec, adults have been reported from July to September (Larochelle 1978, Pilon and Sylvestre 1984).

Sympetrum rubicundulum (Say) [the Ruby Meadowhawk] breeds in ponds, ditches, marshes and slow streams, and is generally eastern in distribution (Needham and Westfall 1954, Walker and Corbet 1975, Brunelle 1997). It was quite rare in PEINP (1.4% of total) but was found in several sites throughout all regions (Table 1). Walker and Corbet (1975) report it to be a late flying species. In Quebec (Pilon and Sylvestre 1984) and PEINP, the Ruby Meadowhawk had a flight period of early July to late August (Fig. 2), compared to June through September in Maine (Brunelle 1999b).

Sympetrum vicinium (Hagen) [the Yellow-legged Meadowhawk] has a mainly eastern distribution, but also occurs along the west coast of North America (Walker and Corbet 1975). It breeds in slow streams and ponds, and is reported to be one of the last species still flying in the fall (Walker and Corbet 1975). In PEINP, it was represented by a single individual collected at Will's Pond (Stanhope area; Table 1) in mid-September, but has been collected elsewhere in PEI as late as November (R. Harding, Personal Communication).

Significance of Odonata to PEINP

Damselflies and Dragonflies are diverse and conspicuous members of the PEINP fauna, and are important predators in and around ponds and other freshwater habitats. Their life history patterns mean that they bridge the gap between the terrestrial and aquatic habitats, since the larvae spend from one to several years growing in ponds or streams, then the adults emerge as winged insects into the terrestrial environment. The relatively long larval life means that Odonata are good indicators of environmental stress (Carle 1979, Clark and Samways 1996, Bulankova 1997). Habitat destruction and pollution has been identified as a major threat to Odonata throughout the world (Moore 1982), with extinctions occurring throughout the developed and developing world. Odonata are also reported to be susceptible to pesticide contamination, and may take a long time to recover after stress because of their long life cycles (Takamura et al. 1991). Stream species in particular, have been reported to be at risk, due to the widespread loss of undisturbed stream habitat, especially in parts of the United States. PEI has few stream species when compared to neighbouring provinces, and Brunelle (1997) has attributed this species pattern to the destruction of suitable stream habitat by agriculture and other land use practises. Despite its small size, PEINP has a relatively high diversity of Odonata, and these may be useful bioindicators for monitoring future development effects within the park.

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Appendix

"Dragonflies and Damselflies of Prince Edward Island National Park"

Donna Giberson and Michelle Dobrin

A photographic guide to the species in the park, and abridged for this report.

Note: This guide was originally set up in booklet format, with photographs of the species presented on the same page as the species accounts. For this report, the photos are presented in two plates, with the species accounts following.

"Dragonflies and Damselflies of Prince Edward Island National Park"

Donna Giberson and Michelle Dobrin

Introduction

Dragonflies and Damselflies are showy insects, usually seen around ponds and streams on bright sunny days. Their popularity has grown dramatically in recent years, as shown by the fact that they are one of the few insect groups to have common names for most of its members. In PEI National Park, they are mainly seen near standing water; look for them around the Farmlands and Bubbling Springs Trails in Stanhope, off the Reeds and Rushes boardwalk near Dalvay Pond, and along the Dunelands Trail near Cavendish Beach. They are most active on sunny and warm days, and different species can be seen from early summer right through September and October, as long as the weather stays mild.

About Dragonflies and Damselflies

The Dragonflies and Damselflies make up a single Order in the Class Insecta. Most people easily recognise an adult dragonfly or damselfly; they have 2 pairs of long, clear, many-veined wings, biting mouthparts, very large eyes, and a long slender abdomen. The wings and body may be brightly and strikingly coloured, and they are excellent fliers. Both the adults and larvae are predatory, feeding mainly on smaller invertebrates (including mosquitoes and black flies).

The larval stages are spent in the water, and different species can be found in virtually all types of permanent freshwater and brackish habitats. Unlike the adults, the larvae are dull coloured and well camouflaged, and are not often seen. Life cycles can extend over several years in some species, though many complete their cycle in about a year. The larvae have a unique mouthpart that is extendible; that is, it is modified to shoot out from the face area to help capture prey. Dragonfly and Damselfly larvae, like all other insects, must moult (shed their skin) to grow; they do this between 10 and 15 times. At the end of the life cycle, the larvae usually climb out of the water for their final moult, then they split the skin along the back, and the adult crawls out. The wings are pumped up with blood and allowed to dry (sometimes over several hours), then the adult flies away. This newly emerged adult is weak and somewhat dull coloured (this is referred to as being "**teneral**"), and the colours brighten over the next few days.

Adults can live for several weeks, and often fly far from their larval habitat. They also have a unique way of mating. The male must first fill a pouch at the front of his abdomen with sperm; he does this by bending his abdomen in a circle until it reaches the pouch. Then he locates a female and grasps her behind her neck, and while the two of them are still flying, she bends her abdomen to the sperm pouch, forming something of a heart shape. In many species, the male will remain attached to the female until she subsequently deposits her eggs, effectively

preventing any other male from mating with the female. Other species guard the female or good egg-laying sites, and will chase away any other dragonflies that come near.

Dragonfly or Damselfly??

The Odonata are made up of two suborders, the Anisoptera (Dragonflies) and the Zygoptera (Damselflies). They are quite distinctive, and can easily be told apart. The Zygoptera are usually small and slender, and they have similar sized front and hind wings which are held over their backs at rest. Their larvae are also relatively slender, and have 3 leaf-like "tails" or caudal filaments at the end of the abdomen.

The Anisoptera (Dragonflies) are usually larger in size and more robust than the Zygoptera. The hind wings are broader at the base than the front wings, and they are held straight out from the body at rest. The larvae are also robust, and don't have the leaf-like tails at the end of the abdomen; instead, there are three stout valves around the anus.

The Guide

Thirty-eight species of dragonfly and damselfly have been recorded to date from Prince Edward Island National Park (PEINP), representing more than half of the total so far recorded from all of Prince Edward Island. The records come from weekly collections and observations along pathways and pondsides in the park between 1997 and 1999. For each species, habitat and distributional information is given (based on literature information and personal observations; see the bibliography at the end of the guide for a list of further reading on the subject), and the flight periods and PEINP distributions are also included.

The following is the key to the locations used in the text (see Fig. 1 of the main report (p. 3) for locations):

BE - Bell's Pond
CL - Clark's Pond
RO - Rolling's Pond
BG Bog Pond
DA - Dalvay Pond
SC - Schooner Pond
BH - Balsam Hollow Brook
JA - John Archie's Pond
SW - Lake of Shining waters
BW - Bowling Pond
LS - Long Pond (Stanhope)
WL - Will's Pond
CA - Campbell's Pond
LG - Long Pond (Greenwich)

Part 1: Species Summary for PEI National Park

Suborder Zygoptera –the Damselflies

Family Lestidae – Spreadwings

Spreadwings are a group of relatively large and elongate damselflies. Their name comes from their habit of holding their wings slightly apart when at rest, unlike other damselflies which hold their wings directly over their backs. Spreadwings breed in still waters such as marshes, bogs, ponds, and small lakes. There is only one genus in the family in Canada; the genus *Lestes*. Four species have been recorded from the park. *Lestes dryas* is quite distinctive, but the other three are similar and cannot be distinguished in the field.

Spreadwings:

Lestes dryas	Emerald Spreadwing
L. disjunctus	Common Spreadwing
L. congener	Spotted Spreadwing
L. forcipatus	Sweetflag Spreadwing

Family Coenagrionidae – Pond Damsels

The Pond Damsels are small and delicate damselflies (usually 2-3 cm long) that prefer still water habitats. Most of these are brightly coloured in blues and greens, and one genus has a metallic shine. The Coenagrionidae are a large and diverse family, with 15 genera found in North America, and four in PEI National Park. Several of these species cannot be distinguished in the field.

Bluets:

Enallagma boreale	Boreal Bluet
E. cyathigerum	Northern Bluet
E. ebrium	Marsh Bluet
E. hageni	Hagen's Bluet
Coenagrion resolutum	Taiga Bluet

Forktails:

Ischnura verticalis	Eastern Forktail

Sprites:

Nehalennia irene	Sedge Sprite

Suborder Anisoptera – the Dragonflies

Family Aeshnidae – Darners

The Darners are large, conspicuous and colourful dragonflies. They have large eyes, a robust thorax and a slender abdomen with blue or green stripes on a brown or black body. The males tend to be striped with blue, whereas females are more green in colour. Both sexes have two paddle-shaped appendages at the tip of the abdomen, and females have strong ovipositors (egg-laying structures) for inserting eggs into plant stems. Two genera of Aeshnidae have been recorded in the park.

Darners:

Aeshna canadensis	Canada Darner
A. constricta	Lance Tipped Darner
A. i. interrupta	Variable Darner
A. tuberculifera	Black-tipped Darner
A. u. umbrosa	Shadow Darner
Anax junius	Common Green Darner

Family Corduliidae – the Emeralds

The Emeralds are medium to large in size, and are brightly coloured. They have dark bodies with brassy or green metallic colouration and most have irridescent green eyes when alive. They breed in streams and well oxygenated lakes and ponds. The family is fairly diverse in PEI National park, with 9 species in 4 genera.

Emeralds:

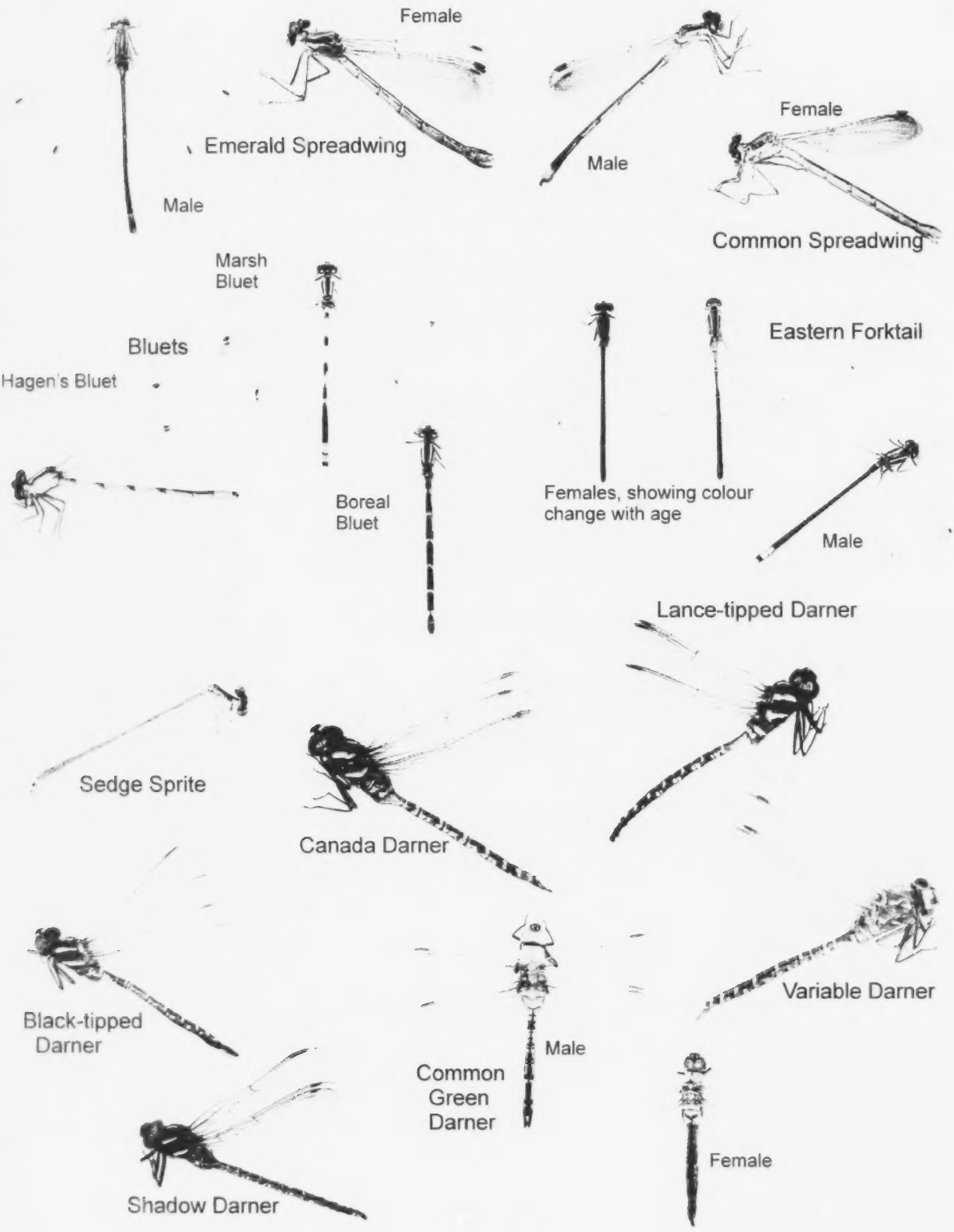
Cordulia shurtleffi	American Emerald
Dorocordulia libera	Racket-tailed Emerald
Epitheca canis	Beaverpond baskettail Emerald
E. spinigera	Spiny baskettail Emerald
Somatochlora elongata	Ski-tailed Emerald
S. franklini	Delicate Emerald
S. kennedyi	Kennedy's Emerald
S. walshii	Brush-tipped Emerald
S. williamsoni	Williamson's Emerald

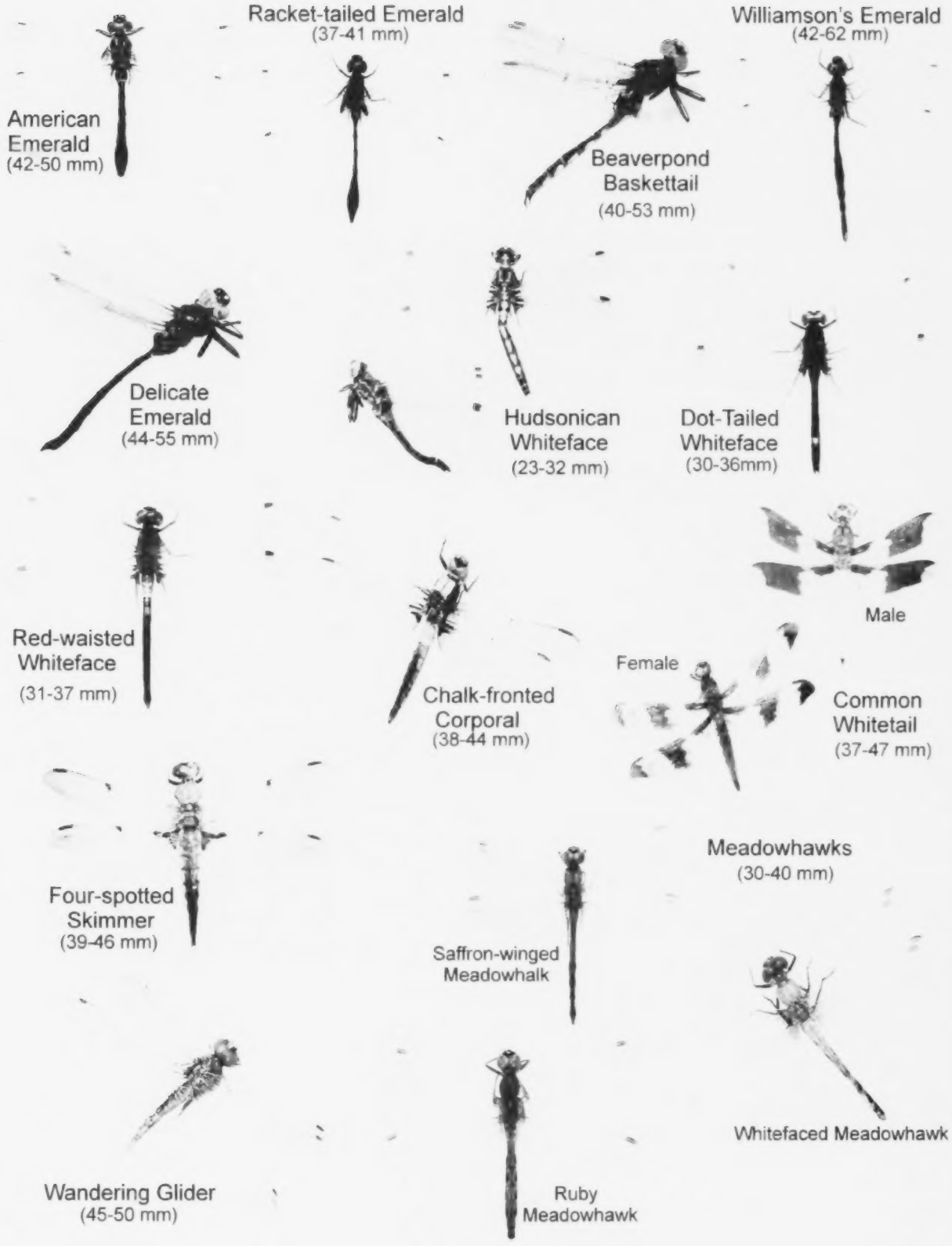
Family Libellulidae – the Skimmers

The skimmers are the most common dragonflies in PEINP, and the largest family of Anisoptera. These dragonflies can be distinguished from other dragonflies by their wide, flat abdomens. They are most common around quiet waters, but can be found in most habitats. There are 12 species in 4 genera in PEI National Park.

Skimmers:

Leucorrhinia hudsonica	Hudsonian Whiteface
L.e. intacta	Dot-tailed White face
L.e. proxima	Red-tailed Whiteface
Libellula julia	Chalk-fronted Corporal
Li. lydia	Common Whitetail
Li. quadrimaculata	Four-spotted Skimmer
Pantala flavescens	Wandering Glider
Sympetrum costiferum	Saffron-winged Meadowhawk
S. internum	Cherry-faced Meadowhawk
S. obtrusum	Whitefaced Meadowhawk
S. rubicundulum	Ruby Meadowhawk
S. vicinum	Yellow-legged Meadowhawk


Female
Emerald Spreadwing
Male
Female
Male
Common Spreadwing
Marsh
Bluet
Bluets
Hagen's Bluet
Boreal
Bluet
Eastern Forktail
Females, showing colour
change with age
Male
Lance-tipped Darner
Sedge Sprite
Canada Darner
Black-tipped
Darner
Male
Common
Green
Darner
Variable Darner
Female
Shadow Darner


American Emerald
(42-50 mm)
Racket-tailed Emerald
(37-41 mm)
Beaverpond Baskettail
(40-53 mm)
Williamson's Emerald
(42-62 mm)
Delicate Emerald
(44-55 mm)
Hudsonican Whiteface
(23-32 mm)
Dot-Tailed Whiteface
(30-36mm)
Red-waisted Whiteface
(31-37 mm)
Chalk-fronted Corporal
(38-44 mm)
Male
Female
Common Whitetail
(37-47 mm)
Four-spotted Skimmer
(39-46 mm)
Meadowhawks
(30-40 mm)
Saffron-winged Meadowhalk
Whitefaced Meadowhawk
Wandering Glider
(45-50 mm)
Ruby Meadowhawk

Part 2: Distributions and Phenology of PEINP Species:

1. Family Lestidae – Spreadwings

a. *Lestes dryas* (Emerald Spreadwing)

Description: Length: 33 – 43 mm. This is a dark species with pale blue eyes (when alive) and a blue face. It is easy to recognise in the field because of its bright metallic green thorax and abdomen.

Habitat: The Emerald Spreadwing breeds in permanent and temporary ponds or in pond habitat within slow streams. The species was common in PEINP but was almost exclusively restricted to the area around a small temporary bog along the Farmlands Trail (near Long Pond, Stanhope).

Distribution: This species is found from BC to the maritimes, and north to Yukon and the Northwest Territories, but has not been recorded from Newfoundland.

PEINP: LS, DA

Flight period: Late May to July or August

b. *Lestes disjunctus disjunctus* (Common Spreadwing); *Lestes congener* (Spotted spreadwing); *Lestes forcipatus* (Sweetflag Spreadwing)

Description: Length: 33-43 mm. These three species cannot be told apart in the field. Their bodies are coppery coloured with dark patches along the back, and theymay have a bluish coloured powder ("pruinosity") over the thorax and parts of the abdomen. Females are usually stockier than the males, and have less extensive pruinosity.

Habitat: The Common Spreadwing prefers boggy and marshy habitats with abundant vegetation. The Spotted Spreadwing usually breeds in permanent and semi-permanent ponds, and in pond areas of slow streams. The Sweetflag Spreadwing inhabits marshy areas, permanent and temporary ponds, and slow weedy streams.

Distribution: The **Common** and **Spotted Spreadwings** have a widespread Canadian distribution and are found from BC to Nfld, and north to NWT. Both are common in PEINP. Both species were common in PEINP. The **Sweetflag Spreadwing** has been recorded as far west as Saskatchewan and is present in all three maritime provinces. It was rare in PEINP.

PEINP: Common Spreadwing: CL, SW,JA, BE, WL, LS, DA,CA,BW,BG,SC
Spotted Spreadwing: BH, JA, WL, LS, DA, CA
Sweetflag Spreadwing: DA, SC (rare)

Flight Period: Common Spreadwing: June – September
Spotted Spreadwing: July – October
Sweetflag Spreadwing: too rare to determine for PEINP, but the single specimen was collected in late August.

2. Family Coenagrionidae – Pond Damsels

a. Bluets: *Enallagma boreale* (Boreal Bluet), *E. cyathigerum* (Northern Bluet), *E. ebrium* (Marsh Bluet), *E. hageni* (Hagen's Bluet) and *Coenagrion resolutum* (Taiga bluet)

Description: 25 – 40 mm. Bluets are usually small and delicate damsels which cannot be distinguished in the field. Males have a bright blue thorax and abdomen with black markings. Females are not as brightly coloured, and may be tan or yellowish green.

Habitat: Bluets breed in ponds and marshes, and occasionally in slow moving streams. Enallagma hageni is also found in bogs.

Distribution: These species are all widely distributed across Canada. The **Marsh Bluet** and **Hagen's Bluet** extend from BC to Nfld and the **Boreal Bluet**, **Northern Bluet** and **Taiga Bluet** also extend into the arctic. **Hagen's Bluet** and the **Marsh Bluet** were both very common in PEINP; the other species were generally rare.

PEINP: Boreal Bluet: SW, JA, BE, WL, LS, DA
Northern Bluet: JA, BE, WL
Marsh Bluet: CL, SW, RO, WL, DA, CA, BG
Hagen's Bluet: CL,SW,BH,JA,BE,WL,LS, DA, CA, BG, LG, SC
Taiga Bluet: CL, JA

Flight Period: Marsh Bluet: Late June to Early September
Hagen's Bluet: early June to Mid-August
Other bluets were too rare to establish a flight period for PEINP

b. *Ischnura verticalis* (Eastern Forktail)

Description: Length: 20 – 33 mm. This is a relatively small and delicate species. The males have a bright green thorax and the abdomen is dark with a blue area near the tip. The females are usually orange, but may have similar colour patterns to the male. Individuals become covered in a dark blue powdery substance (pruinosity) as they mature, so the entire body looks uniformly dark in older individuals.

Habitat: This species breeds in still waters and slow streams and backwaters.

Distribution: This is mainly an eastern species, and is one of the most common damselflies in eastern Canada. It is found throughout the maritimes, and west to Manitoba. This was the second most common damselfly in PEI National Park, and was found throughout the park.

PEINP: CL, SW, BH, RO, JA, BE, WL, LS, DA, CA, BW, SC

Flight Period: June to mid-September

c. *Nehalennia irene* – Sedge Sprite

Description: Length 24 - 30 mm. This is a tiny and delicate species, and males and females have similar colouration. The thorax and abdomen are bright metallic green, and the tip of the abdomen is bright blue. The sedge sprite may be confused with the eastern forktail because of the blue-tipped abdomen, but the eastern forktail is not metallic.

Habitat: The Sedge Sprite breeds in boggy waters, marshes, and sedge fens, but the adults are generally found in heavily vegetated areas where they may be difficult to see.

Distribution: The Sedge Sprite is widespread across Canada, extending from BC to the maritimes, and north to NWT. It was relatively rare in PEINP.

PEINP: JA, LS, BG

Flight Period: This species was too rare to establish a flight period for PEINP, but was observed in June and July.

3. Family Aeshnidae – Darners

a. *Aeshna canadensis* (Canada Darner)

Description: Length: 64–74 mm. Canada Darners have a greenish-blue face and a blue and black body with yellow spots. The stripes on the thorax are sinuate (wavy) and are blue near the top and green below, with yellow spots between the stripes. Canada Darners may be confused with Lance-tipped Darners (Aeshna constricta), but can be distinguished by the yellow spots between the stripes, which are not present in A. constricta. Females are similar to the males, except that the pale colours are yellowish or grass-green.

Habitat: Canada Darners are found around marshes, bog-margined lakes, ponds, or sluggish streams.

Distribution: The Canada Darner has been recorded from all 10 Canadian provinces, but is more common in the east than in the west. It is quite common in PEI National Park, but seems more common than it is because it is so showy and conspicuous.

PEINP: BH, JA, BE, LS, BG, LG, SC

Flight Period: This is the earliest of the Darners to be seen in PEINP; it has been observed between mid-June and September.

b. *Aeshna constricta* (Lance-tipped Darner)

Description: Length: 68 – 72 mm. The colour patterns are very similar to the Canada Darner (*A. canadensis*) (i.e. green and blue stripes on the thorax, and blue markings down the abdomen), except that the stripes on the thorax are not as wavy, and there are no spots between the stripes. Similarly to the Canada Darner, the female colour patterns are similar to the male, but generally paler.

Habitat: The Lance-tipped Darner breeds in waters with emergent vegetation, such as open marshes, ponds, and slow-moving streams. Adults are usually found along the margins of these habitats.

Distribution: This is a mainly eastern species, although it does extend into western Canada. It is found in all the maritime provinces.

PEINP: CL, SW, BH, JA, BE

Flight Period: This is a summer and fall species, and was observed in PEINP during August and September.

c. *Aeshna interrupta interrupta* (Variable Darner)

Description: Length: 66 – 77 mm. The Variable Darner has a pale olive-green face, and the markings on the body are a pale blue. This species can be distinguished from the other Darners by the pattern of the stripes on the thorax; rather than being continuous, they are either separated or constricted in the middle. *Aeschna i. interrupta* is the eastern subspecies and the one found in this area. The female is similar to the male pictured above, but is paler in colour.

Habitat: The Variable Darner is usually found near still waters like bogs, marshes, ponds (including beaver ponds) and slow streams.

Distribution: This subspecies is found in eastern Canada and the northeastern states. It was relatively common in PEINP.

PEINP: CL, JA, BE, WL, LS, DA, BG, LG, SC

Flight Period: This is a strictly summer species, occuring between late June and late August in PEINP.

d. *Aeshna tuberculifera* (Black-tipped Darner)

Description: Length: 71– 80 mm. The Black-tipped Darner is similar to other Darners in the park, except that the stripes on the thorax are broad and straight, and the last abdominal segment is completely black. Females and males have similar colouration.

Habitat: The Black-tipped Darner can be found around grassy or boggy edges of ponds or lakes.

Distribution: This species has been recorded in all the maritime provinces, Ontario, Quebec, and BC. It was rare in PEI National Park, represented by a single female observed in 1997at Will's Pond in the Stanhope area.

PEINP: WL

Flight Period: This species was too rare to determine a flight period, but the single individual was observed in late August.

e. *Aeshna umbrosa umbrosa* (Shadow Darner)

Description: Length: 64 – 78 mm. This is a dark-coloured Darner, with straight, yellowish, stripes on the thorax. The blue markings on the abdomen are smaller and less conspicuous than other Aeshna species.

Habitat: The Shadow Darner prefers partly shaded streams and ditches. They are most active during the late afternoon and evening during the summer, but will fly in bright sunshine later in the year when the temperatures are cooler.

Distribution: There are two sub-species in this group; *A. u. umbrosa* is transcontinental and *A. u. occidentalis* which occurs in the west. The Shadow Darner is common and widespread in the east and was one of the common Darners in PEI National Park.

PEINP: BE, WL, LS, DA, CA

Flight Period: The Shadow Darner can be seen all summer at PEINP, from mid-June to mid-September.

f. *Anax junius* (Common Green Darner)

Description: Length: 68 – 80 mm. This is the largest dragonfly in the park, with a wingspan measuring up to 11 cm. Males and females differ strikingly in colour; males have a green thorax with a blue and black abdomen, whereas females have a green thorax with a red and black abdomen. Both sexes have a yellowish-green head with characteristic "bull's eye" pattern on the top.

Habitat: Common Green Darners are usually seen near still or slow moving waters with abundant emergent vegetation. They are strong and agile flyers and can be very difficult to catch.

Distribution: This species has a transcontinental distribution, and also extends southward to Central and South America. They are known to migrate from the south to more northerly locations in the spring. It was rare in PEI National Park.

PEINP: CA

Flight Period: The Common Green Darner was too rare in PEINP to establish a flight period, but was seen in early August.

4. Family Corduliidae – The Emeralds

a. *Cordulia shurtleffi* (American Emerald)

Description: Length: 42-50 mm. The American Emerald has metallic green eyes and a dark metallic thorax and abdomen without any spots.

Habitat: The American Emerald breeds in quiet, still waters such as marshes, beaver ponds, and sphagnum bogs.

Distribution: The American Emerald is primarily eastern in distribution in Canada, although it extends into the Northwest Territories and Yukon. It is found in all four Atlantic Provinces. It was relatively common in PEI National Park.

PEINP: JA, BE, WL, LS

Flight Period: Adults can be seen in PEINP during July and August.

b. *Dorocordulia libera* – Racket-tailed Emerald

Description: Length: 37 – 41 mm. This is a relatively small Emerald. Like other members of the group, it has iridescent green eyes when alive (which fade quickly in preserved specimens). The thorax and abdomen have a bronzy-green sheen in both sexes. The front part of the abdomen is extremely narrow in the males and somewhat stouter in the females.

Habitat: The Racket-tailed Emerald breeds in quiet waters like bogs, marshy edges of lakes, and slow streams.

Distribution: This species has a northeastern distribution, and has been recorded in all the maritime provinces, but not in Newfoundland. It was relatively rare in PEI National Park.

PEINP: LS, SC

Flight Period: This species was too rare to determine the flight period, but was seen through June and July in PEINP.

c. *Epitheca canis* (Beaverpond Baskettail) and Epitheca spinigera (Spiny Baskettail)

Description: Length: 40 – 53 mm. These two species cannot be distinguished in the field. They are moderate-sized dragonflies, with the iridescent green eyes that are characteristic of the family and a dark T-spot on the top of the head. Bodies are stout and hairy and brownish in colour (without a metallic lustre), with dull yellow markings on the thorax and abdomen.

Habitat: The Beaverpond Baskettail breeds in boggy areas and is often found in acidic waters. The **Spiny Baskettail** is found near the marshy areas of lakes and slow streams.

Distribution: Both species have a transcontinental distribution and have been recorded from the three maritime provinces. The **Beaverpond baskettail** was rare in PEINP, and only collected near Will's Pond, a beaver pond along the Farmlands Trail near Stanhope. The Spiny Baskettail was also collected along the Farmlands trail, but near Long Pond.

PEINP: Beaverpond Baskettail: WL;
Spiny Baskettail: LS

Flight Period: Both of these species were too rare to adequately describe the flight periods, but the Beaverpond Baskettail was collected in early June in PEINP, and the Spiny Baskettail was collected from early June to early August.

d. *Somatochlora elongata* (Ski-tailed Emerald); *Somatochlora walshii* (Brush-tipped Emerald), and *Somatochlora williamsoni* (Williamson's Emerald)

Description: Length: 42 – 62 mm. These three species cannot be distinguished in the field. They have the emerald green eyes characteristic of the family, with dark metallic green to black bodies and two equal yellow spots on the sides of the thorax.

Habitat: All three species breed in streams but their individual habitats differ slightly. The **Ski-tailed Emerald** prefers lake outlets and streams with riffle and pool areas; the **Brush-tipped Emerald** inhabits slow streams running through bogs and marshes; and **Williamson's Emerald** is found in slow streams running through shaded, forested areas.

Distribution: The Ski-tailed Emerald is an eastern species, and has been recorded in all three maritime provinces. The Brush-tipped Emerald is transcontinental in distribution. Williamson's Emerald extends from Manitoba to New Brunswick and PEI. None of these species were very common in PEINP (especially the Ski-tailed Emerald), but they were generally widespread throughout the park.

PEINP: Ski-tailed Emerald: LS
Brush-tipped Emerald: CL, WL, LS
Williamson's Emerald: CL, WL, LS, DA, CA, BG

Flight Period: Ski-tailed Emerald:too rare to determine, collected in late July
Brush-tipped Emerald: late June – late July
Williamson's Emerald: late June – late July

e. *Somatochlora franklini* (Delicate Emerald) and *Somatochlora kennedyi* (Kennedy's Emerald)

Description: Length 44 – 55 mm. These two Emeralds cannot be distinguished in the field, but differ from the other species of *Somatochlora* in the park by having 2 unequal yellow spots on the sides of the thorax. Their bodies are dark metallic green or black and they have the characteristic bright green eyes of the family.

Habitat: Both the **Delicate Emerald** and **Kennedy's Emerald** breed in boggy waters; the Delicate Emerald prefers spring-fed sphagnum bogs and Kennedy's Emerald is found in open, shallow, boggy areas.

Distribution: Both of these species are eastern species. The range of the **Delicate Emerald** extends westward to Saskatchewan and it has been recorded in all the Atlantic provinces. **Kennedy's Emerald** has been recorded as far west and north as Manitoba and the Northwest Territories as well as the maritimes. These Emeralds were rare in PEI National Park, and were only found near Long Pond near Stanhope.

PEINP: Delicate Emerald: LS
Kennedy's Emerald: LS

Flight period: Both species were too rare in PEINP to establish flight periods, but they were observed flying in June and July.

5. Family Libellulidae – The Skimmers

a. *Leucorrhinia hudsonica* (Hudsonian Whiteface)

Description: Length: 23 – 32 mm. The members of this genus are called "Whitefaces" because of their characteristic white face. The females of all three Whitefaces in the park are similar and difficult to distinguish in the field, but the males can usually be told apart. The Hudsonian Whiteface is a small species and males have a black abdomen irregularly spotted with red. The females have a black abdomen spotted in yellow rather than red.

Habitat: This species breeds in marshes, bogs and ponds that have still, cold waters.

Distribution: The Hudsonian Whiteface is transcontinental, extending in Canada from BC to Newfoundland and north to Alaska, Yukon, and NWT. In PEINP, it was only found near a small temporary bog along the Farmlands Trail near Stanhope.

PEINP: LS

Flight Period: Adults have been observed in June in PEINP.

b. *Leucorrhinia intacta* (Dot-tailed Whiteface)

Description: Length: 30 – 36 mm. This species has the characteristic white face and dark abdomen of the genus, but males can be distinguished from the other Whitefaces in the park by the presence of a single yellow or red spot about 3/4 down the abdomen. Females may have several yellowish spots on the abdomen, and be difficult to distinguish from the other whitefaces.

Habitat: The Dot-tailed Whiteface has been recorded breeding in a variety of habitats, including marshes, ponds, slow streams, and farm ponds.

Distribution: This species extends across Canada to BC, and is common in the maritime provinces. It has not been recorded in Newfoundland. It was common in PEINP but was only found in the Stanhope/ Brackley area of the park.

PEINP: JA, WL, LS

Flight Period: Adults were recorded during June and July in PEINP.

c. *Leucorrhinia proxima* – Red-waisted Whiteface

Description: Length: 31– 37 mm. This species has the characteristic white face and dark abdomen of the genus, but males can be distinguished from the other Whitefaces in the park by the red colour at the front of the abdomen, and the lighter segments following. Females can be similar to the males, but may also be confused with the other Whitefaces found in the park.

Habitat: The Red-waisted Whiteface breeds in still waters, such as marshes and bogs.

Distribution: The Red-waisted Whiteface is widely distributed in Canada, extending from the Atlantic provinces (including Nfld) west to BC and north into the NWT and Yukon. This is the most common Whiteface in PEINP, and it was found in a number of locations in the Stanhope and Greenwich areas of the park.

PEINP: JA, BE, WL, LS, DA, BG, SC

Flight Period: Adults were observed in PEINP from early June to early August.

d. *Libellula julia* (Chalk-fronted Corporal)

Description: Length: 38 – 44 mm. Members of this genus have stout bodies with wide, flat abdomens. The Chalk-fronted Corporal is a medium sized species with whitish powder (pruinosity) along the top of the thorax and the front of the abdomen. Females are similar to males, but have a greyish pruinosity rather than white.

Habitat: This species is found around bogs, ponds and swampy areas.

Distribution: The Chalk-fronted Corporal has a transcontinental distribution, but is not common on the prairies. It has been recorded from all three maritime provinces. It was rare in PEINP, represented by a single specimen observed near Dalvay Pond in June 1999.

PEINP: DA

Flight Period: The species was too rare to establish a flight period for PEINP, but the single specimen was observed in late June.

e. *Libellula lydia* – Common Whitetail

Description: Length: 37 – 47 mm. This is one of the most distinctive dragonflies in PEI National Park. It is a medium-sized species with a wide, flat abdomen that tapers towards the tip, which is covered by a whitish powder (pruinosity) in mature individuals. Males have wide dark bands in the centre of the wings, and a smaller dark area at the bases of the wings. Females have three distinct bands, one at the wing tip, one in the centre of the wing, and another at the wing base.

Habitat: The Common Whitetail breeds in quiet areas of small ponds.

Distribution: This species is common in the maritimes, extending westward into Quebec and Ontario, and is also recorded from BC. It is common in PEINP, and can frequently be seen near the small impoundment at Green Gables Golf course, near Green Gables House, and along the Farmlands trail near Stanhope.

PEINP: SW,BH, WL, LS

Flight Period: Adults have been observed in PEINP from late June to late August.

f. *Libellula quadrimaculata* (Four-spotted Skimmer)

Description: Length: 39 – 46 mm. This is one of the most common dragonflies in the Park. It has an olive-brown, yellow, and black body with the wide, flat abdomen that is characteristic of the genus. Each wing has a dark spot in the centre of the leading edge, and the hind wings are darkly tinted at the base.

Habitat: The Four-spotted Skimmer breeds in still waters, such as marshes and peaty bogs.

Distribution: This species is circumboreal (found in the boreal region of North America as well as Eurasia), and is found all across Canada. It was found at nearly every collecting site in PEI National Park.

PEINP: CL, SW, BH, JA, BE, WL, LS, DA, CA, BG, SC

Flight Period: This is one of the first dragonflies to be seen in the park in summer, and is a summer species. Adults can be seen from early June into August.

g. *Pantala flavescens* (Wandering Glider)

Description: Length: 45 – 50 mm. This is a relatively large dragonfly with large broad wings and a stout yellow and black abdomen. The eyes are yellowish and turn red as the insect matures. The males and females have similar colouration.

Habitat: This species breeds in open, temporary habitats like temporary ponds. Adults may drift long distances with the wind.

Distribution: This is the only dragonfly that has been reported to have a world-wide distribution. It is known from PEI from a single mating pair collected near Green Gables house in 1997, and has been found in most Canadian provinces.

PEINP: BH

Flight Period: This species was too rare in PEINP to establish a flight period, but the mating pair were observed near the end of August.

h. Meadowhawks: *Sympetrum costiferum* (Saffron-winged Meadowhawk), *Sympetrum internum* (Cherry-faced Meadowhawk), *Sympetrum obtrusum* (Whitefaced Meadowhawk), *Sympetrum rubicundulum* (Ruby Meadowhawk), *Sympetrum vicinum* – Yellow-legged Meadowhawk

Description: Length: most are 30 – 40 mm. Meadowhawks are the most common dragonflies in PEINP, but they are very difficult to distinguish in the field. The males of all species have bright red bodies and abdomens and females are usually yellow to orange. The wings usually have a yellowish tinge at the bases.

Habitats: Saffron-winged Meadowhawk: in marshes and shallow, sandy ponds.
Cherry-faced Meadowhawk: ponds, slow streams with lots of shade.
White-faced Meadowhawk: temporary ponds, marshes and streams.
Ruby Meadowhawk: ponds, ditches, open marshes,sluggish streams.
Yellow-legged Meadowhawk: slow streams and permanent ponds.

Distribution: Saffron-winged Meadowhawk: transcontinental
Cherry-faced Meadowhawk: transcontinental and north into NWT.
Whitefaced Meadowhawk: transcontinental and north into NWT.
Ruby Meadowhawk: eastern: not recorded in NB or Nfld.
Yellow-legged Meadowhawk: generally eastern, rare in PEINP

PEINP: Saffron-winged Meadowhawk: CL, SW, BH, BE, LS, DA, CA
Cherry-faced Meadowhawk: CL, SW, BH, LS, CA
Whitefaced Meadowhawk: CL, SW, BH, JA, BE, WL, LS, DA, CA, BW, BG, SC
Ruby Meadowhawk: SW, BH, RO, JA, DA, CA
Yellow-legged Meadowhawk: WL

Flight Periods: These are late summer species, flying from July to September

Parcs Canada, région de l'Atlantique, produira trois séries de rapports en sciences des écosystèmes afin de communiquer de nouvelles données scientifiques, de consigner des données scientifiques, et de résumer les connaissances existantes ou de formuler des recommandations d'ordre technique. La fonction principale et le public visé détermineront la série dans laquelle un rapport sera publié. Chaque série contiendra des informations scientifiques et techniques qui viendront enrichir les connaissances existantes, mais ne pourraient être publiées dans les revues professionnelles en raison de leur présentation.

- ***Les Rapports techniques en sciences des écosystèmes - Parcs Canada*** favoriseront la diffusion à grande échelle d'information scientifique et technique tirée des études spéciales effectuées par Parcs Canada. La matière traitée et la série reflètent l'intérêt et les politiques de Parcs Canada dans de nombreux aspects des sciences des écosystèmes. La série comprendra des inventaires d'écosystèmes, des inventaires de ressources, des études diverses, des relevées sur des espèces ou des guildes et des concepts innovateurs de gestion.
- ***Les Rapports d'études en matière de sciences des écosystèmes - Parcs Canada*** permetteront la publication de comptes rendus, de bibliographies et d'études d'options en matière de gestion faites par Parcs Canada. Les descriptions et les analyses de ressources sont aussi publiées dans cette série, en entier ou en partie.
- ***Les Rapports de surveillance et de données relatives aux écosystèmes - Parcs Canada*** offriront un moyen de présenter des compilations de données sans analyse détaillée. En général, ce genre de compilation sert à appuyer des publications scientifiques ou des rapports techniques en sciences des écosystèmes. Parcs Canada publiera dans cette série des données brutes qui ne sont pas inclues dans une banque de données nationale et qui méritent l'archivage.

Rapports en sciences des ecosystèmes sont publiés dans la langue officielle choisie par l'auteur en fonction du public visé, avec un résumé dans la deuxième language officielle.

Objectifs
Ces séries de rapports serviront à :

- communiquer les résultats des recherches effectuées en sciences des écosystèmes aux scientifiques et aux gestionnaires, ainsi qu'aux membres du public que les activités enterprises par Parcs Canada en écologie et en conservation intéressent.
- offrir des publications professionnelles, crédibles et précises qui seront soumises à l'évaluation par les pairs.
- favoriser la diffusion de l'information, la créativité, l'efficacité et le travail d'équipe dans les projets de recherche.

Évaluation par les pairs
Le rédacteur nommera deux lecteurs choisis, dans la mesure du possible, parmi le personnel scientifique de Parcs Canada, qui seront chargés de faire une critique de chaque manuscrit. On fera appel à des lecteurs de l'extérieur en raison de l'expertise exigée, du temps disponible et de l'objectivité nécessaire. Les lecteurs renverront le manuscrit au rédacteur en y joignant leurs commentaires par écrit. Le rédacteur renverra le manuscrit à son ou à ses auteurs avec les commentaires des lecteurs. L'auteur prendra connaissance des commentaires et tiendra compte de ceux avec lesquels il est d'accord, puis il retournera le manuscrit révisé au rédacteur en lui expliquant par écrit pourquoi il n'a pas tenu compte de certains commentaires. Le rédacteur enverra ensuite le manuscrit au garde de parc en chef, ou, s'il s'agit d'employés du bureau régional, au superviseur immédiat de l'auteur, pour faire approuver la publication et l'impression du manuscrit. Dans le cas de publications de moindre importance, le rédacteur peut, à sa discrétion, décider de ne pas avoir recours à des lecteurs; lui-même et le superviseur immédiat de l'auteur serviront alors de lecteurs. En cas de désaccord entre l'auteur et le rédacteur au sujet du manuscrit, c'est le gestionnaire ministériel principal qui tranchera.

Directives à l'intention des auteurs
Ces séries de rapports seront consacrées à la publication de travaux effectués dans la région de l'Atlantique en science des écosystèmes et seront mises à la disposition de tous les employés de Parcs Canada, du ministère du Patrimoine canadien, de leurs collaborateurs ou de toute personne qui travaille pour le compte de Patrimoine canadien.

Les auteurs soumettront au rédacteur régional une copie de leur manuscrit sur support en papier, une version sur disquette en WordPerfect Windows ou DOS et le nom de trois lecteurs éventuels qui ne connaissent pas le manuscrit.

Pour de plus amples renseignements, communiquez avec :

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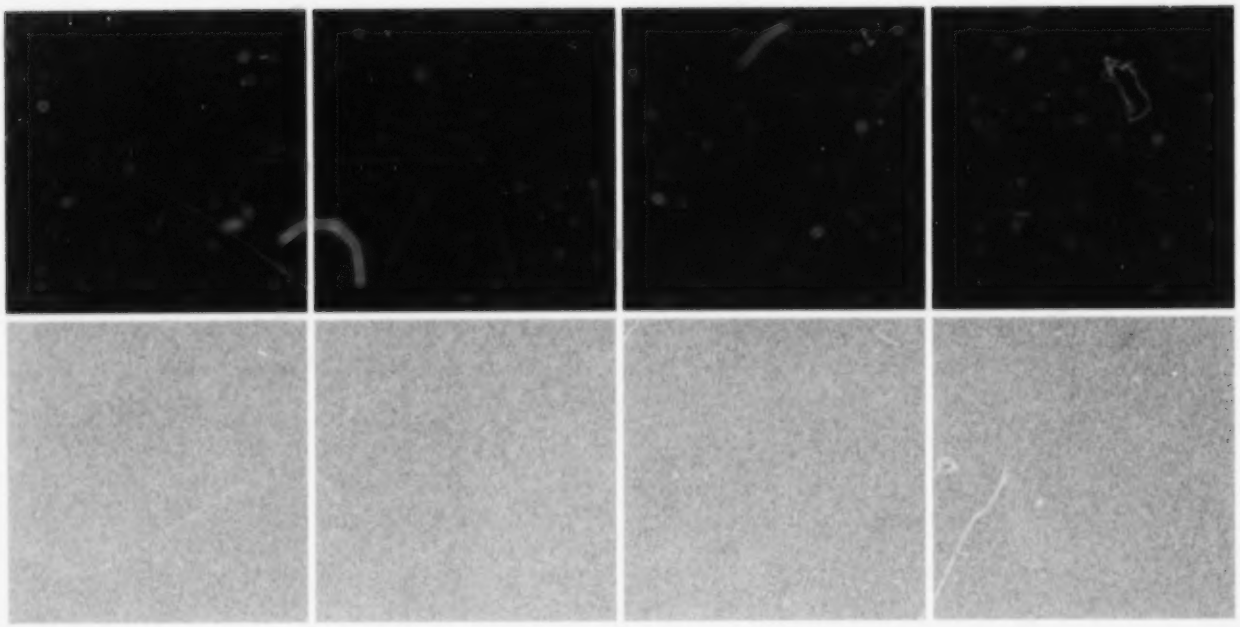

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